DOCUMENT RESUME

ED 076 385 SE 015 845

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TITLE The Effect of Immediate Environment on Children's Tendency to Reflect While Solving Problems.
PUB DATE Feb 73
NOTE 25p.; Paper presented at the annual meeting of the American Educational Research Association (New Orleans, Louisiana, February 25-March 1, 1973)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Behavior; *Children; Dialogue; *Environmental Influences; *Problem Solving; Reports; Research; *Self Control; Testing
IDENTIFIERS Research Reports

ABSTRACT

Compared were children's reflective behavior in the classroom to their reflective behavior in individual environments. Examined were three environmental variables in terms of the way each affected reflective behavior in children. The variables are (1) report card grades vs. no grades for performance, (2) individual vs. classroom environment, and (3) dialogue with an adult vs. written test conditions. Results of testing showed that even though children differed in reflectivity within a testing condition, children taking written tests were in general more reflective than children tested under dialogue conditions. It was concluded that it would be unwise for educators or researchers to directly compare problem-solving scores obtained in different test environments. Also, teacher-student dialogue appears to be a particularly difficult environment for children working on complex problems. This rapid communications system apparently serves to discourage children from processing information sufficiently and therefore from solving complex problems. (PL)

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THE EFFECT OF INTERMEDIATE ENVIRONMENT ON CHILDREN'S TENDENCY TO REFLECT WHILE SOLVING PROBLEMS

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Using the Matching Familiar Figures (MFF) test and other measures, Jerome Kagan has related the child's failure to solve complex problems to his impulsiveness rather than to his IQ. Impulsive children respond too quickly and make errors. In the present study, urban sixth-graders were found to be far more impulsive under Kagan's dialogue condition than under any of four written test conditions. Likewise, suburban first-, third- and fifth-graders were far more impulsive under dialogue than under group written conditions. Adult-student dialogue serves to discourage children from processing information sufficiently and therefore from solving complex problems.

Paper presented at annual convention of the American Educational Research Association, New Orleans, Feb. 25-Mar. 1, 1973

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There are somewhat consistent individual differences among children in their cognitive disposition to be slow and accurate or fast and inaccurate when solving complex problems having several alternatives (Kagan, 1965). The reflective child examines evidence more carefully for a longer time and makes fewer errors than the impulsive child (Drake, 1970). Differences in reflection-impulsivity are most often measured by Kagan's Matching Familiar Figures Test (MFF). Each test item contains a familiar drawing and six or eight facsimiles. The task is to choose the one facsimile which exactly matches the drawing.

Impulsivity has been related to memory problems, poor reading (Kagan, 1965), difficulty with inductive reasoning tasks (Kagan, Pearson, & Welch, 1966), and school failure (Messer, 1970).

There has been concern with finding environmental variables which may increase children's reflectivity. Children who watched adult models (Debus, 1970) or who were subjected to induced failure (vs. induced success) at another task (Messer, 1968) later showed significantly increased times but not increased accuracy on the MFF. However, direct

training (Briggs, 1966) and a year's exposure to a reflective teacher (Yando & Kagan, 1968) resulted in both increased times and increased accuracy.

Only one study dealt with testing environment. "Warm vs. cold" individual testing conditions were found to have little effect (Kagan, Rosman, Day, Albert, & Phillips, 1964). The study did not examine how students might behave in group environments.

In fact, the entire reflectivity literature is void of studies of children's behavior in group environments, most notably the classroom. Inferences are made from the literature that the critical variables are the same for individual and group environments.

The present study compares children's reflective behavior in the classroom to reflective behavior in individual environments.

The present study examines three environmental variables in terms of the way each affects reflective behavior in children. The variables are (a) report card grades vs. no grades for performance; (b) individual vs. classroom environment; and (c) dialogue with an adult vs. written test conditions.

Method

Ss were 156 sixth graders in urban public schools (Fall River, Massachusetts). Most were from lower- or working-class families. The mean IQ was 101.

Testing conditions included five alternatives. Kagan's dialogue condition, in which the individual answered orally and was told whether he was correct; and four written-test conditions, in which S simply wrote a number designating his answer and received no feedback. The four written conditions were individual testing, with report card grades; individual-no grades; group-grades; and group-no grades.

The first eight items of the MFF, Set 1-S (juvenile version) were used. Ss in adjoining seats received booklets with the items in different random sequences. In all cases, there was no time limit; in the group conditions, S raised his hand when finished and received a crossword puzzle to do. Two Es worked together to administer the test to each class.

Tests were scored for number of items correct and for mean time per item; i.e., decision time to first response, not including answer-writing time (5 seconds per item) or page-turning time (6 seconds per item).

Results

Correlations under Different Test Environments

The product-moment correlations among IQ, MFF score, and MFF time under each of the five testing conditions are presented in Table 1. (See Table 2 for Ns.) In each of the five environments, MFF score was not significantly correlated with IQ; correlation ranged from .05 to .32.

Insert Table 1 about here.

Table 1

Grade 6: Intercorrelations of MFF Score, MFF Time,

and IQ Under Each Condition

Condition	IQ x MFF score	IQ x MFF time	MFF Score x MFF Time
Individual -			
Grades	.05	-.27	.03
Individual -			
No Grades	.09	.18	.62**
Group - Grades	.07	-.20	.35*
Group - No Grades	.16	.34*	.48**
Dialogue			
Condition	.32	.17	

* $p < .05$

** $p < .01$

In four of the five environments, MFF time was not significantly correlated with IQ; correlations ranged from -.27 to +.34. Thus IQ is relatively independent of accuracy and time across environments.

MFF score and MFF time were significantly correlated in three of the four environments, indicating that the distinction between reflective (slow, accurate) and impulsive (fast, inaccurate) students is valid across a variety of testing conditions.

Grades vs. No Grades and Individual vs. Group Environments

Means and standard deviations of each measure in each test environment are presented in Table 2. Two-way analyses of variance showed the

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Insert Table 2 about here.

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effects of Grades vs. No Grades and Individual vs. Group conditions on MFF scores and times. All measures were taken under written testing conditions.

The variables did not affect scores but did affect time spent. Table 3 shows that MFF score was not significantly affected by the presence

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Insert Table 3 about here.

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or absence of grades or by the individual or group test environment. Table 4 shows that students tested under group conditions spent a

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Insert Table 4 about here.

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significantly longer time per item than did students in the individual

Table 2

Grade 6: Means and Standard Deviations

for each Test Condition

Condition	No. correct			Time/item (sec.)		N	M
	N	M	SD	M	SD		
Individual-Grades	22	5.3	1.7	40.4	19.8	21	110.1
Individual No Grades	24	5.2	2.0	49.0	29.4	22	100.6
Group - Grades	46	5.7	1.8	65.4	28.9	44	99.0
Group - No Grades	39	5.5	1.7	50.4	19.3	38	97.2
Dialogue Condition	25	3.8	1.5	24.8	11.9	19	103.5

Table 3

Grade 6: Analysis of Variance on MFF

Score (Number Correct)

Source	df	F
Grades vs. No Grades (A)	1	.5
Individual vs. Group (B)	1	1.2
A x B	1	.0
Error	127	

Table 4

Grade 6: Analysis of Variance on MFF

Time (Mean Time per Item in Seconds)

Source	df	F
Grades vs. No Grades (A)	1	2.9
Individual vs. Group (B)	1	8.2**
A x B	1	6.6*
Error	127	

* $p < .05$

** $p < .01$

test environment ($F = 8.2$, $p < .01$). Grades alone did not significantly affect time. The interaction of grades and group environment had a significant effect on time ($F = 6.6$, $p < .05$). That is, students in the Group-Grades condition spent an especially long time on the MFF test.

Effects of Dialogue on Reflectivity

Reflectivity was tested under a fifth condition, a dialogue condition corresponding to Kagan's original test environment used in virtually all previous studies of reflectivity. Scores under the dialogue condition were compared to scores under each of the four written test conditions by use of a t test. Students under dialogue conditions scored significantly lower in every comparison (see Table 5). The mean score for dialogue condition students was 3.8 correct, while the mean scores in

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Insert Table 5 about here.

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the written conditions ranged from 5.2 to 5.7 correct.

Likewise, students under dialogue conditions took significantly less time than those under each of the written conditions (see Table 5). Mean time per item averaged 24.8 seconds under the dialogue condition and ranged from an average of 40.4 seconds to 65.4 seconds under the written conditions. In sum, the dialogue condition students were a great deal more impulsive than were students in any of the four written conditions. Dialogue appears, then, to seriously hamper reflective thought.

Table 5

Grade 6: *t* Tests Comparing Dialogue Condition to Four Written Test Conditions on Each Reflectivity Measure

Source	Score		Time
	df	*t*	*t*[a]
Dialogue *vs.*			
Individual-Grades	45	-3.2**	-3.3**
Dialogue *vs.*			
Individual-No Grades	47	-2.6*	-3.8**
Dialogue *vs.*			
Group-Grades	69	-4.4**	-8.4**
Dialogue *vs.*			
Group-No Grades	62	-3.9**	-6.7**

[a]Absence of homogeneity of variance called for use of an adjusted *t* test (see Ferguson, 1959, pp. 143-145); degrees of freedom are not indicated for an adjusted *t*.

*$p < .05$

**$p < .01$

Method

Ss were first graders, third graders, and fifth graders in suburban public schools (Newton, Massachusetts). The school neighborhoods were predominantly upper middle class. At each grade level, Ss were tested under either individual dialogue conditions or group written-test conditions.

The test consisted of a twelve-item MFF in versions at a suitable difficulty level for each grade. Ss in adjoining seats received booklets with items in different random sequences. In class, each first grader circled his answer; each third- or fifth-grader recorded the number designating his answer.

Tests were scored for number of items correct and for mean response time per item, as in the Grade 6 study.

For the fifth graders, two versions of the MFF test were used. The version administered second was identical to the first, except that the answer alternatives were rearranged in position.

Results

Correlations under Different Test Environments

The product-moment correlations for the Grade 5 individual conditions were .12 between IQ and MFF score was .12, and between IQ and MFF time was .18. For the Grade 5 group condition the correlation between IQ and MFF score was .36 ($p < .05$) and between IQ and MFF time was -.10. (See Table 7 for N's.) Too few IQ scores were available in

grades 1 and 3 to do a correlation. Thus the reflectivity measures were relatively independent of IQ across environments. The correlations between MFF Score and MFF Time are presented in Table 6 for each grade level.

Insert Table 6 about here.

The correlations are all significant and reasonably high across both the individual and group conditions. The dichotomy of reflective (slow-accurate) and impulsive (fast-inaccurate) appears valid across the grade levels and individual vs. group conditions of this study.

Individual vs. Group Environments

Means and standard deviations of each measure in each test environment for grades 1, 3 and 5 are presented in Table 7. The individual and group conditions were compared on each measure. (See Table 8).

Insert Table 7 about here.

Insert Table 8 about here.

For each of grades 1, 3 and 5, students under the group condition scored significantly higher and took significantly longer than did students tested under the individual condition. In short, classroom students are more reflective than individually tested students.

Table 6

Correlations of MFF Score, MFF Time, and IQ

		N	MFF Score x MFF Time
Grade 1	Dialogue	38	.53
	Group	43	.36
Grade 3	Dialogue	48	.66
	Group	42	.68
Grade 5	Dialogue	49	.61
	Group	54	.56

		N	IQ x MFF Score	IQ x MFF Time
Grade 5	Dialogue	44	.12	.18
	Group	46	.36	-.10

Table 7

Means and Standard Deviations of MFF Score and MFF Time

		MFF Score			MFF Time (sec.)	
		N	$\bar{X}$	S.D	$\bar{X}$	S.D.
Grade 1	Dialogue	38	4.58	2.07	138.5	59.1
	Group	43	5.74	2.12	353.5	191.2
Grade 3	Dialogue	48	5.46	2.60	491.1	423.1
	Group	42	6.67	2.95	743.8	358.4
Grade 5	Dialogue	49	6.22	2.21	534.6	298.0
	Group	54	7.54	2.30	842.8	299.5

Table 8

t Tests Comparing Dialogue Condition to

Group-Written Condition on MFF Score and MFF Time

	MFF Score	MFF Time
	t	*t*
Grade 1	2.92**	5.18**
Grade 3	2.04*	3.00**
Grade 5	2.46*	6.57**

* $p < .05$

** $p < .01$

The Second Testing

The two fifth grade classes that were tested individually the first time were tested as a group the second time. The two classes tested as a group first were tested individually the second time. The mean MFF scores and MFF times for each testing are presented in Table 9. The two test versions were counterbalanced across groups and testings. The means for the two versions were so nearly

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Insert Table 9 about here.

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identical that they are not presented separately. (See Tables 10 and 11.)

A three factor analysis of variance with the third factor being the repeated one was used on the MFF Score. (See Table 10.) The two test versions were virtually identical in score ($F=0.2$) across the two testings. It made little difference whether the individual or group condition was first ($F=0.2$). The students, on the average, improved somewhat on the second testing ($F=5.7$, $P<.05$). Students scored higher in the group condition than in the individual condition regardless of which was given first ($F=34.8$, $P<.01$). The other interactions in the analysis showed negligible differences.

Insert Table 10 about here.

A similar three factor analysis of variance with the third factor repeated was done on MFF Time. (See Table 11.) The students, on the average, took less time on the second testing ($F=26.9$, $P<.01$).

Table 9

Grade 5: Means of MFF Score (No. Correct) and MFF Time (Mean Sec./Item) for the First and Second Testing

Condition	N	MFF Score		MFF Time	
		First Testing	Second Testing	First Testing	Second Testing
Individual Testing First, Group Second	47	6.3	8.4	45.1	60.6
Group Testing First, Individual Second	54	7.5	6.6	70.2	27.4

Table 10

Grade 5: Repeated Measures Analysis of Variance on MPF Score (Number Correct)

Source	df	MS	F
Between Subjects	100		
Test Version (A)	1	1.4	.2
Individual vs. Group (B)	1	1.7	.2
A x B	1	9.0	1.1
Error (Between)	97	8.4	
Within Subjects	101		
First vs. Second Testing (c)	1	16.0	5.7*
A x C	1	.1	.0
B x C	1	98.0	34.8**
A x B x C	1	.1	.0
Error (Within)	97	2.8	

* $p < .05$

** $p < .01$

The students took longer in the group condition than in the individual condition, regardless of the sequence of the two conditions ($F=130.2$, $P<.01$). The other factors and interactions had a negligible effect.

Insert Table 11 about here.

The main finding of the above two analyses is that classes that behave impulsively (fast, inaccurate) when tested individually will become much more reflective (slow, accurate) when tested as a group. The group condition produces much more reflective behavior regardless of whether it occurs before or after the individual condition.

To determine how well the construct reflection-impulsivity holds across conditions, the MFF measures from the individual and group conditions were correlated (See Table 12). The correlations between

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Insert Table 12 about here.

MFF Score and MFF Score across two conditions were .46 and .55. The correlations between MFF Time across the two conditions were .44 and .36. MFF Score in one condition was correlated with MFF Time in a different condition. The correlations were .10, .58, .22, and .41, and the average correlation was .36. Thus, in general, there was a moderate consistency of the reflection-impulsivity dimension that held across group and individual environments.

Table 11

Grade 5: Repeated Measures Analysis of Variance on MFF Time

Source	df	MS	F
Between Subjects	100		
Test Version (A)	1	1537	.0
Individual vs. Group (B)	1	66561	.7
A x B	1	94509	1.0
Error (Between)	97	92447	
Within Subjects	101		
First vs. Second Testing (c)	1	1150146	26.9**
A x C	1	54438	1.3
B x C	1	5560696	130.2**
A x B x C	1	22905	.5
Error (Within)	97	42702	

**$p < .01$

Table 12

Grade 5: Intercorrelations of MFF Score and MFF Time for First and Second Testing Under Individual and Group Conditions

First Testing	MFF Score	MFF Time	MFF Score	Ti
Second Testing	MFF Score	MFF Time	x MFF Time	Sc
Individual Condition 1st				
Group Condition 2nd	.46**	.44**	.10	.58**
Group Condition 1st				
Individual Condition 2nd	.55**	.36**	.22	.41**

**$p < .01$

Discussion

Children can reasonably be classified as reflective (slow, accurate) and impulsive (fast, inaccurate) under both dialogue and group testing conditions. Even though children differ in reflectivity within a testing condition, children taking written tests are in general far more reflective than children tested under dialogue conditions. First graders tested under group-written conditions took about as long as did college graduates tested under individual-dialogue conditions by Yando & Kagan (1968). Virtually none of the students tested under group-written conditions would be classified as "impulsive" using the dialogue condition norms from Kagan's original work.

On the basis of the present study, we conclude it would be unwise for educators or researchers to directly compare problem-solving scores obtained in different test environments. More importantly, we conclude that teacher-student dialogue appears to be a particularly difficult environment for children working on complex problems. Dialogue is a rapid-tempo communications system with time gaps of a fraction of a second between the utterances of two speakers. This rapid communications system apparently serves to discourage children from processing information sufficiently and therefore from solving complex problems.

Footnotes

[1]This study was supported by the Harvard University Milton Fund Program and the Boston University Grants-in-Aid Program.

[2]Requests for reprints should be sent to Thomas M. Edwards, Coordinator of Testing, University of Illinois at Chicago Circle, Student Counseling Service, (Box 4348) Chicago, Illinois 60680.

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